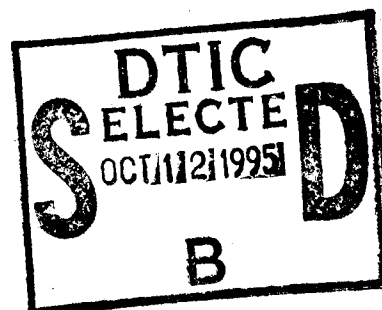


PL - TR-95-2010
Special Reports, No. 273

SATELLITE AND SPACE SHUTTLE EXPERIMENTS FLOWN BY
THE GEOPHYSICS DIRECTORATE AND OTHER UNITS OF
PHILLIPS LABORATORY AT HANSCOM AFB, MA AND BY
THEIR PREDECESSOR ORGANIZATIONS, 1958 - 1994.

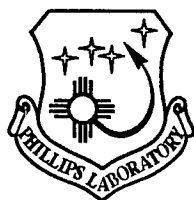
Ruth P. Liebowitz

16 January 1995



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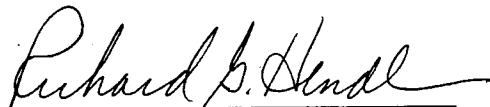
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PHILLIPS LABORATORY
Directorate of Geophysics
AIR FORCE MATERIEL COMMAND
HANSCOM AIR FORCE BASE, MA 01731 - 3010

DTIC QUALITY INSPECTED 5

This technical report has been reviewed and is approved for publication.

A handwritten signature in cursive script, reading "Richard G. Hendl", written in dark ink. The signature is fluid and stylized, with a long horizontal stroke at the end.

(Signature)

Dr. Richard G. Hendl
Chief Scientist

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Satellite and Space Shuttle Experiments
Flown by the
Geophysics Directorate and Other Units of Phillips Laboratory
at Hanscom AFB, MA.
and by
Their Predecessor Organizations
1958 - 1994

Compiled by
Dr. Ruth P. Liebowitz
Historian
Phillips Laboratory
Hanscom AFB, MA.

Preface

This report contains a comprehensive listing of space experiments conducted since 1958 by the Geophysics Directorate and other units of Phillips Laboratory at Hanscom AFB, MA, and their predecessor organizations. It marks the first time the satellite and Space Shuttle experiments of these organizations have been collected in one volume.

The listing is intended to provide a summary guide to the Directorate's long-standing and broad-ranging programs of orbital space probes. Experiments have measured electromagnetic radiation and high-energy particles coming in from the sun, the characteristics of near-Earth space, and phenomena at lower altitudes or at the Earth's surface that are accessible from a space platform, to mention some of the major program areas.

In the late 1940s and early 1950s the original Geophysics Research Directorate built up expertise in probe instrumentation and experimental practice through its sounding rocket program. This expertise was transferred to satellites in the late 1950s. The organization, which then became the Air Force Cambridge Research Laboratories, managed a series of research orbiting vehicles in the mid-1960s and built two of them (OV 3-5 and OV 3-6) completely in-house. However, most of its space experiments have "piggybacked" rides on a variety of satellites flown by DOD and also by NASA.

Since the early 1980s Air Force geophysicists have also flown experiments on the new Space Shuttle. All told, the number of satellite experiments flown by these Hanscom organizations and their predecessors totals more than 350 and the number of Space Shuttle experiments reaches 50.

In this report, the summary of Space Shuttle programs is preceded by the much longer satellite listing. Readers who seek detailed information on launch sites, vehicles, orbits, etc. are referred to the TRW Space Log.

The historian appreciates the help received from many scientists and engineers in checking the accuracy of the entries. Ms. Evelyn Kindler edited and formatted the information to create the final copy, and her contribution is gratefully acknowledged.

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RPL
Hanscom AFB, MA
November 1994



AFRL staff prepare the ATCOS II satellite (OV3-6) for pre-flight testing, 1967.

AFCRC/AFCL/AFGL/Phillips Lab - Hanscom Satellite Experiments
1958 - Present*

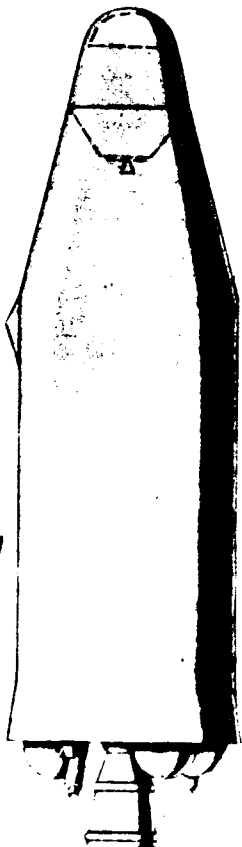
* As of November 1994

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
1 Feb 1958	Explorer I (1958-Alpha)	USA		Micrometeorite Detector (Microphone)	Atlantic Missile Range (AMR) Launch Success
26 Mar 1958	Explorer III (1958-Gamma)	USA		Micrometeorite Detector (Grid)	AMR Launch Success
11 Oct 1958	Pioneer I (1958-Eta)	NASA		Micrometeorite Detector	AMR Launch Success
13 Apr 1959	Discoverer 2 (1959-Gamma)	ARPA		Cosmic Ray Emulsions	Western Test Range (WTR) Launch Failure No Capsule Recovery
25 Jun 1959	Discoverer 4	ARPA		Cosmic Ray Emulsions	WTR Launch Vehicle Failure
13 Aug 1959	Discoverer 5 (1959-Epsilon)	ARPA		Cosmic Ray Emulsions	WTR Launch Failure No Capsule Recovery

Satellite Experiments - 1958 - Present (cont.)

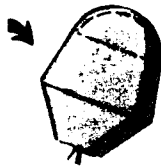
Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
19 Aug 1959	Discoverer 6 (1959-Zeta)	ARPA		Cosmic Ray Emulsions	WTR Launch Failure No Capsule Recovery
20 Nov 1959	Discoverer 8 (1959-Lambda)	USAF		Cosmic Ray Emulsions	Failure No Capsule Recovery
4 Feb 1960	Discoverer 9	USAF	H. Yagoda	Cosmic Ray Emulsions	Failure No Orbit
26 Feb 1960	Midas I	USAF	D. Smart J. McIsaac R. Soberman R. Sagalyn	Cosmic Radiation Monitor Aerospace Density Micrometeorite Detectors (Acoustic & Grid) Plasma Probe (Electric Field Meter)	Vehicle Failure
11 Mar 1960	Pioneer V (1960-Alpha)	NASA	R. Soberman	Micrometeorite Detector (Microphone)	Inconclusive Data
15 Apr 1960	Discoverer 11 (1960-Delta)	USAF	R. Soberman	Micrometeorite Detector (Microphone)	Failure No Capsule Recovery

DISCOVERER II



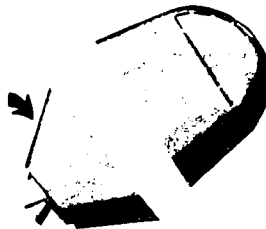
Discoverer II in orbit. The re-entry vehicle 1 is outlined by the dotted lines.

RE-ENTRY VEHICLE



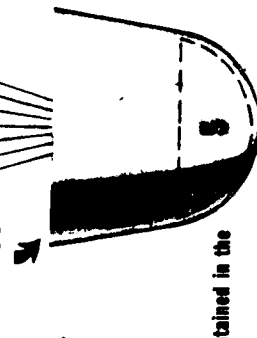
Re-entry vehicle after separation from Discoverer II.

AFTER STRUCTURE



The after structure which contains the expended retrorocket separates just prior to re-entering the earth's atmosphere.

RE-ENTRY VEHICLE



The re-entry vehicle is supported by the parachute during the final phase of its descent.

Environmental package is contained in the re-entry vehicle cavity.

RECOVERY CAPSULE DISCOVERER SATELLITES

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
24 May 1960	Midas 2 (1960-Zeta)	USAF	D. Smart J. McIsaac A. Jursa R. Soberman R. Sagalyn	Cosmic Radiation Monitor Aerospace Density (Density Gauge) Radiometric Measurements Micrometeorite Detectors (Acoustic & Grid) Plasma Probe (Electric Field Meter)	Loss of Telemetry on 2nd Day Data Received Up to Telemetry Failure
10 Aug 1960	Discoverer 13 (1960-Theta)	USAF	H. Yagoda R. Soberman	Cosmic Ray Emulsions Sputtering Measurements	Failure No Capsule Recovery
13 Sep 1960	Discoverer 15 (1960-Mu)	USAF	H. Yagoda	Cosmic Ray Emulsions	Failure No Capsule Recovery
26 Oct 1960	Discoverer 16	USAF	H. Yagoda	Cosmic Ray Emulsions	No Orbit
12 Nov 1960	Discoverer 17 (1960-Omichon)	USAF	H. Yagoda	Cosmic Ray Emulsions	Successful Capsule Recovery (10th Try for Experiment) Discovered Heavy Solar Cosmic Rays

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
7 Dec 1960	Discoverer 18	USAF	H. Yagoda	Cosmic Ray Emulsions	Success Discovered Protons in Trapped Radiation Measured Energy Spectrum
31 Jan 1961	Samos 2 (1961-Alpha 1)	USAF	R. Soberman R. Soberman	Micrometeorite Detectors (Acoustic-3) Micrometeorite Detectors (Grid-2)	Success
16 Jun 1961	Discoverer 25 (1961-Xi)	USAF	H. Yagoda D. Smart J. McIsaac R. Soberman	Cosmic Radiation (Nuclear Emulsions & Metals) Cosmic Ray Monitor Aerospace Density (Gauge-2) Micrometeorite Detector Acoustic & Grid)	Success Partial Success Failure
7 Jul 1961	Discoverer 26 (1961-Pi)	USAF	H. Yagoda D. Smart L. DellaLucca J. Ulwick	Cosmic Radiation (Emulsions) Cosmic Ray Monitor Micrometeorite Detectors (Acoustic & Grid) Galactic Radio Noise	Success Partial Failure Partial

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
12 Jul 1961	Midas 3 (1961-Sigma)	USAF	D. Smart H. Hinteregger A. Jursa L. DellaLucca	Cosmic Ray Monitor Retarding Potential Analyzer Radiometers (Infrared) Micrometeorite Detector (Membrane)	First WTR Launch Partial Partial Failure Success No Impacts
3 Aug 1961	Discoverer 28	USAF	D. Smart L. Katz J. McIsaac	Cosmic Ray Monitor Cosmic Ray Monitor Aerospace Density (Gauge-2)	Vehicle Failure No Orbit
30 Aug 1961	Discoverer 29 (1961-Psi)	USAF	L. Katz H. Yagoda	Cosmic Ray Monitor Cosmic Radiation (Metal Samples)	Partial Success
9 Sep 1961	Samos 3	USAF	R. Soberman B. Shuman R. Sagalyn L. Katz J. McIsaac	Micrometeorite Detectors (Acoustic, Grid, & Microphone) Magnetic Fields (Magnetometer) Plasma Probe (Electric Field Meter) Neutron Albedo Aerospace Density (Gauges-2)	Exploded on Launch Pad

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
12 Sep 1961	Discoverer 30 (1961-Omega)	USAF	H. Yagoda J. Ulwick	Cosmic Radiation (Metal Samples) Galactic Radio Noise	Success Partial
17 Sep 1961	Discoverer 31 (1961-AB)	USAF	L. Katz H. Yagoda J. Ulwick	1.5 Mev Extraterrestrial Protons Cosmic Radiation (Emulsions & Metals) Galactic Radio Noise	Failure No Capsule Recovery
13 Oct 1961	Discoverer 32	USAF	H. Yagoda R. Sagalyn	Cosmic Radiation (Emulsions & Metals) Electron Ion Density (Plasma Probes)	Success Success
21 Oct 1961	Midas 4	USAF	L. Katz	Cosmic Radiation (HEP-2 Instruments)	Success
23 Oct 1961	Discoverer 33	USAF	H. Yagoda	Cosmic Radiation (Emulsions & Metals)	Failed to Orbit
5 Nov 1961	Discoverer 34	USAF	H. Yagoda J. Ulwick	Cosmic Radiation (Emulsions & Metals) Spatial & Temporal Electron Density Variations	Capsule Not Ejected Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
15 Nov 1961	Discoverer 35	USAF	H. Yagoda A. Jursa	Cosmic Radiation (Emulsions & Metals) Radiometric Measurements (2 Sensors)	Success Partial
12 Dec 1961	Discoverer 36	USAF	H. Yagoda L. Katz L. Katz J. Ulwick	Cosmic Radiation (Emulsions & Metals) Cosmic Ray Monitor (CRM-9A) Cosmic Ray Monitor (CRM-8A) Spatial & Temporal Electron Density Variations	Success Experiment Failure Partial Success
27 Feb 1962	Discoverer 38 (1962-Epsilon)	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions & Metals)	Success
9 Apr 1962	Midas 5 (1962-Kappa)	USAF	D. Smart L. Katz H. Yagoda A. Jursa	Cosmic Ray Monitor High Energy Protons Emulsions & Metals-Cosmic Radiation Infrared Radiometric Measurements	Success Success Success Partial

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
18 Apr 1962	No Name (1962-Lambda)	USAF	H. Yagoda L. Katz J. Ulwick A. Jursa	Cosmic Radiation (Nuclear Emulsions) Neutron Albedo Measurements Spatial & Temporal Electron Density Variations Infrared Radiometric Measurements	Success Success Success Failure
26 Apr 1962	Samos 7	USAF	H. Yagoda L. Katz H. Hinteregger J. Ulwick A. Jursa	Cosmic Radiation (Nuclear Emulsions) Neutron Albedo Measurements Retarding Potential Analyzer Spatial & Temporal Electron Density Variations Infrared Radiometric Measurements	Success Success Partial Partial Failure
10 May 1962	ANNA 1A	DOD/ NASA	O. Williams	Project ANNA 1A (Geodetic Satellite)	Failure to Orbit
15 May 1962	No Name (1962 Sigma)	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
30 May 1962	No Name (1962 Phi)	USAF	H. Yagoda H. Hinteregger R. Sagalyn L. Katz J. Ulwick	Cosmic Radiation (Nuclear Emulsions & Metals) Retarding Potential Analyzer Ion & Electron Measurements Beta-Gamma Measurements Electron Density (Impedance Probe)	Success Payload Failure Success Success Payload Failure
2 Jun 1962	No Name (1962-Chi)	USAF	H. Hinteregger J. Ulwick R. Sagalyn H. Yagoda L. Katz	Retarding Potential Analyzer Impedance Probe Ion & Electron Measurements Cosmic Ray Studies (Emulsions & Metals) Beta-Gamma Measurements	Partial Success Success Success Success
23 Jun 1962	No Name (1962-AB)	USAF	J. Ulwick R. Sagalyn L. Katz L. Block	Impedance Probe Measurements Ion & Electron Measurements Beta-Gamma Measurements Infrared Measurements of Agena Plume	Success Success Success Success

Satellite Experiments - 1958 - Present (cont.)

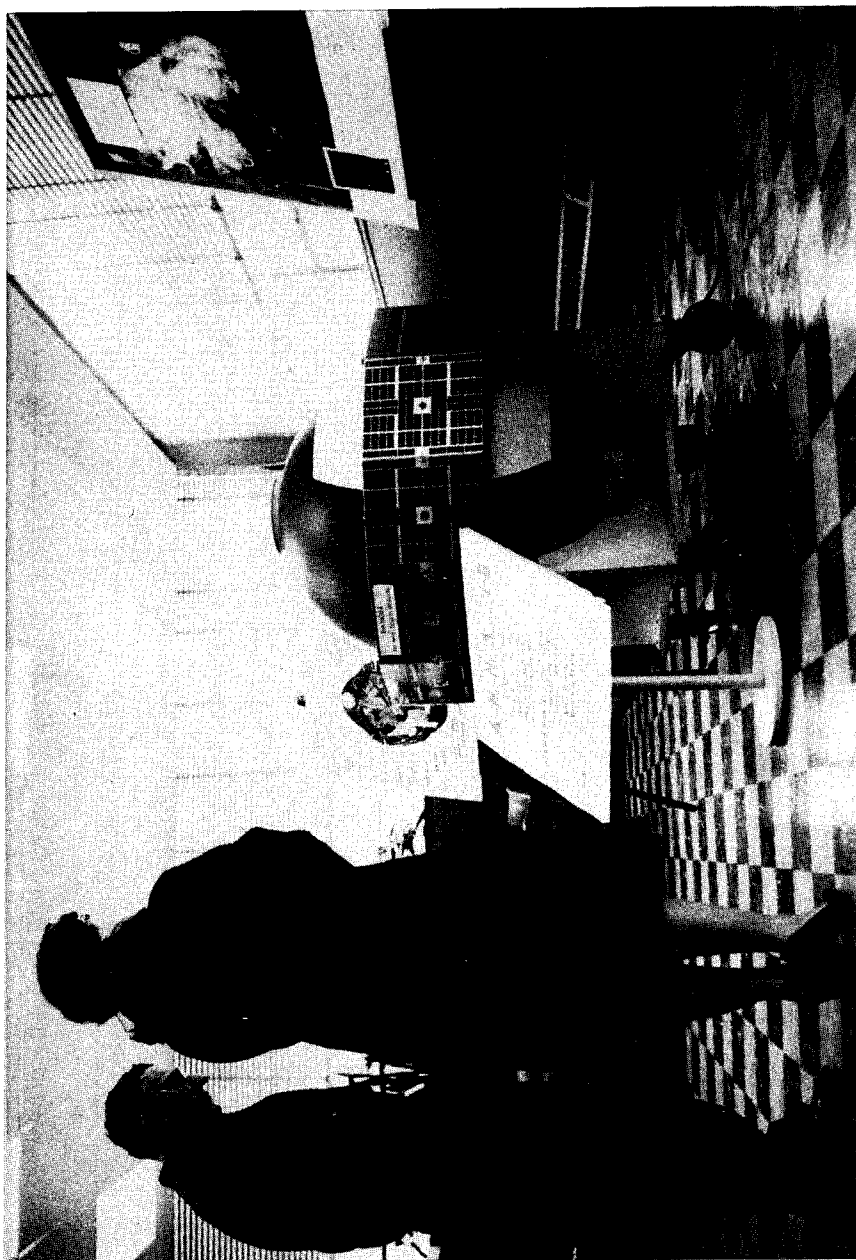
Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
28 Jun 1962	No Name	USAF	H. Yagoda B. Shuman R. Sagalyn L. Katz R. Soberman J. Ulwick	Cosmic Radiation (Nuclear Emulsions) Satellite Magnetic Measurements Ion & Electron Measurements Beta-Gamma Measurements Micrometeorite Detector Electron Density (Impedance Probe)	Success Failure - Satellite Clock Success Success Failure - No Data Success
18 Jul 1962	Samos 9 (1962-AZ)	USAF	L. Katz	Neutron Albedo Measurements	Success
21 Jul 1962	No Name (1962-AH)	USAF	R. Sagalyn L. Katz J. Ulwick H. Yagoda	Ion & Electron Measurements Cosmic Ray Monitor Galactic Radio Noise Cosmic Rays (Emulsions & Metals)	Success Success Success Failure No Recovery
28 Jul 62	No Name	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success Discovered Starfish Caused Increase in Trapped Proton Fluxes

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
2 Aug 1962	No Name (1962-AK)	USAF	J. Ulwick R. Sagalyn L. Katz R. Soberman B. Shuman H. Yagoda	Electron Density (Impedance Probe) Ion & Electron Measurements Beta-Gamma Spectrometric Measurements Micrometeorite Detector Satellite Magnetic Measurements Cosmic Radiation (Nuclear Emulsions)	Telemetry Failure Success Success Telemetry Failure Telemetry Failure Success
29 Aug 1962	No Name	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success
17 Sep 1962	None (ERS-2) (1962-AX)	USAF	H. Yagoda J. Ulwick L. Block L. Katz	Cosmic Radiation (Emulsions) Spatial & Temporal Electron Density Variations Earth Infrared Background Cosmic Ray Neutron Flux	Success Success Success Success Environmental Research (ERS) Subsatellite Failed to Eject
9 Oct 1962	No Name	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
26 Oct 1962	Starad (1962-BK)	USAF	L. Katz	Trapped Particle Measurements	Success Starfish Artificial Radiation Data Returned Until 1/18/63 Success
31 Oct 1962	ANNA 1-B	USAF	J. Ulwick O. Williams	Electron Density (Impedance Probe) Project ANNA 1-B (Geodetic Satellite) Strobe Lights	Success
5 Nov 1962	No Name (1962-BO)	USAF	H. Yagoda	Cosmic Rays (Nuclear Emulsions)	Success
11 Nov 1962	No Name	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success
24 Nov 1962	No Name (1962-BP)	USAF	J. Ulwick L. Lovett	Spatial & Temporal Electron Density Variations Infrared Earth Background Measurements	Success



The Anna 1-B Satellite on Display in the AFCRL Lobby

Satellite Experiments - 1958 - Present (cont.)

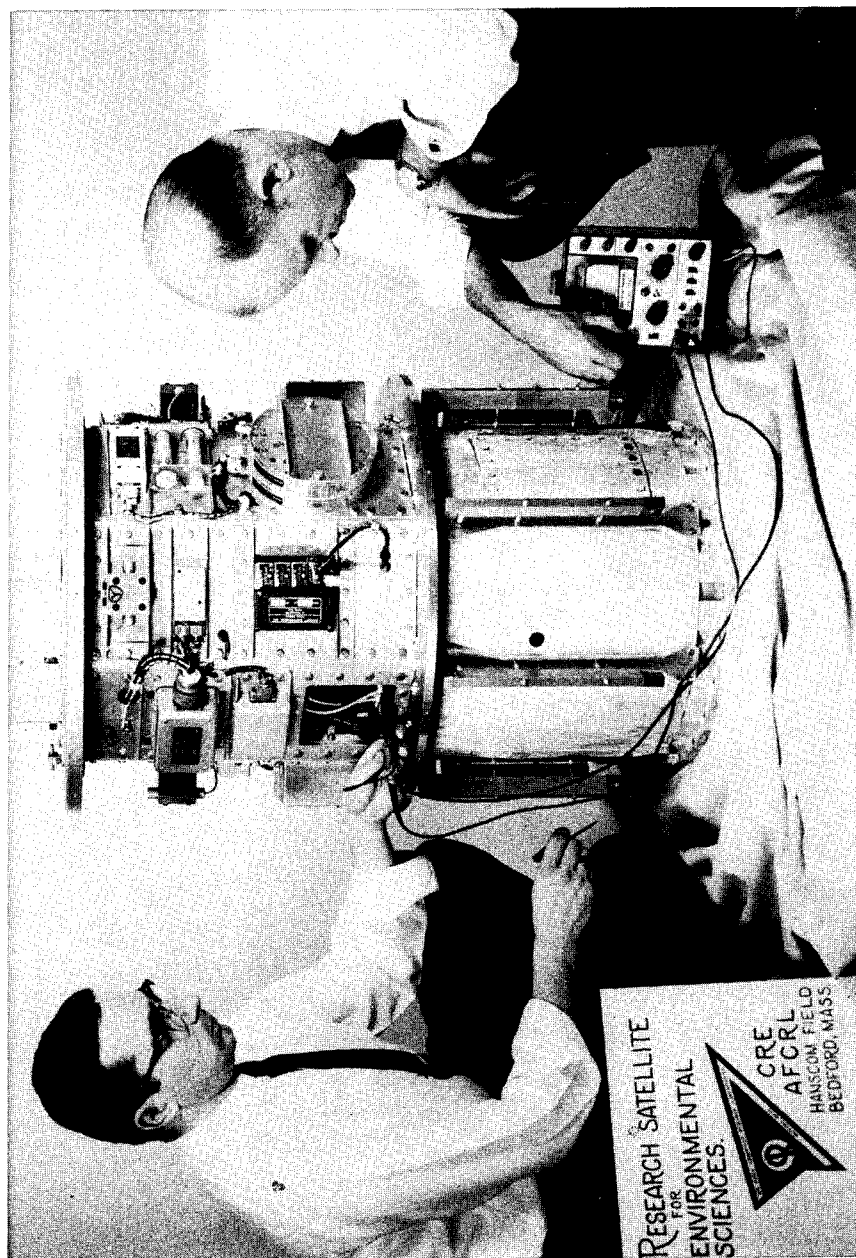
Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
14 Dec 1962	None	USAF	H. Yagoda	Cosmic Radiation (Emulsions & Metals)	Success
17 Dec 1962	None ERS 3&4	USAF	L. Katz L. Block	Cosmic Ray Studies (CRM-2B) Infrared Measurement of Agena Plume	Failed to orbit Carried Environmental Research Subsatellites
18 Mar 1963	P-11	USAF	L. Katz	Cosmic Radiation Subsatellite	Failed to Orbit
1 Apr 1963	No Name (1963-7A)	USAF	H. Yagoda	Cosmic Radiation Studies (Emulsions)	Success
18 May 1963	No Name (1963-16A)	USAF	H. Yagoda	Cosmic Radiation Studies (Emulsions)	Success
12 Jun 1963	No Name (1963-19A)	USAF	H. Yagoda	Cosmic Radiation Studies (Nuclear Emulsions)	Success
27 Jun 1963	No Name (1963-25A)	USAF	H. Yagoda	Cosmic Radiation Studies (Nuclear Emulsions)	Success
27 Jun 1963	P-11 (1963-25B) (HITCHHIKER)	USAF	L. Katz	Trapped Energy Particles	Success Returned Radiation Data for More Than 3 Months

Satellite Experiments - 1958 - Present (cont)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
28 Jun 1963	GRS (1963-26A) (Geophysical Research Satellite)	USAF	R. Narcisi H. Hinteregger	Aerospace Composition Retarding Potential Analyzer	Wallops Island Launch on Scout Success Success (Obtained Space Gas Experiment Data for 13 Orbits)
18 Jul 1963	No Name (1963-28A)	USAF	H. Yagoda	Cosmic Radiation (Emulsions)	Success
31 Jul 1963	No Name (1963-32A)	USAF	H. Yagoda	Cosmic Radiation (Emulsions)	Success
24 Aug 1963	No Name (1963-34A)	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success
29 Aug 1963	No Name (1963-35A)	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success
23 Sep 1963	No Name (1963-37A)	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success
29 Oct 1963	No Name (1963-42A)	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
21 Dec 1963	No Name (1963-55A)	USAF	H. Yagoda	Cosmic Radiation (Nuclear Emulsions)	Success
15 Feb 1964	No Name (1963-8A)	USAF	R. Filz	Cosmic Radiation (Nuclear Emulsions)	Success
21 Apr 1964	No Name	USN	J. Mullen	ORBIS I (Orbiting Ionospheric Beacon)	Failed to Orbit
4 Jun 1964	No Name (1963-26A)	USAF	R. Filz	Cosmic Radiation (Emulsions)	Success
13 Jun 1964	No Name (1964-30A)	USAF	R. Filz	Cosmic Radiation (Emulsions)	
18 Jun 1964	No Name (1964-31A)	USAF	R. Filz	Cosmic Radiation (Emulsions)	Success
26 Jun 1964	Research Satellite for Environmental Sciences	USAF			Scout, Launched from Western Test Range, Failed to Orbit
10 Jul 1964	No Name (1964-37A)	USAF	R. Filz	Cosmic Radiation (Emulsions)	



Checking Instrumentation Signals on the AFCRL Research Satellite for Environmental Sciences, 1964.

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
5 Sep 1964	OGO-A (1964-54A) (Orbiting Geophysical Observatory)	NASA	R. Sagalyn	Positive & Negative Ion & Proton Fluxes & Energies	Eastern Test Range Launch Success
2 Nov 1964	No Name	USAF	R. Filz	Cosmic Radiation (Emulsions)	Success
18 Nov 1964	No Name	USAF	J. Mullen	ORBIS II (Orbiting Ionospheric Beacon)	Success
21 Nov 1964	Injun IV (1964-76B) (Explorer 25)	NASA	R. Sagalyn	Positive & Negative Ions (Ion Trap)	Dual-Payload Launch Successful Experiment
11 Dec 64	Atlas-Centaur 4 (1964-82A)	NASA	H. Hinteregger L. Block	Retarding Potential Analyzer Centaur Plume Measurements	Success Failure (Centaur Payload)
21 Jan 1965	Orbiting Vehicle (OV1-1)	USAF	L. Block R. Soberman J. Ulwick J. Ulwick	IR-UV Radiation (Radiometers) Micrometeorite Detector Radio Noise (Radiometer) Impedance Probe	Failure--No Separation of Orbiting Vehicle from Side Pad of ABRES Vehicle

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
25 Feb 1965	No Name (1965-13A)	USAF	R. Filz	Cosmic Radiation (Emulsions)	Success
3 Apr 1965	1965-27A and B (Snapshot/Secor 4)	USAF/ USA	J. McIsaac R. Sagalyn J. Ulwick R. Soberman	Atmospheric Density (Gauges) Electrical Structure Impedance Probe Micrometeorite Detector	Success Success, Success Success
18 May 1965	No Name (1965-37A)	USAF	R. Filz	Cosmic Radiation (Nuclear Emulsions)	Success
17 Aug 1965	No Name (1965-67A)	USAF	R. Filz	Cosmic Radiation (Nuclear Emulsions)	Success
21 Aug 1965	Gemini V (1965-68A)	NASA	J. Lovett	Radiometric Measurements	Success
25 Aug 1965	OSO-C (Orbiting Solar Observatory)	NASA	H. Hinteregger	EUV Monochromator	Failed to Orbit

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
2 Sep 1965	No Name	USAF	M. Wong J. Aarons J. Ulwick L. Block	Satellite to Satellite Communications Exospheric Radiation Radio Noise IR-UV Optical Measurements	Failed to Orbit
22 Sep 1965	No Name (1965-74A)	USAF	R. Filz	Cosmic Radiation (Nuclear Emulsions)	Success
14 Oct 1965	OGO-2 (1965-81A)	NASA	H. Hinteregger D. Bedo	XUV Spectrophotometer	Partial
15 Oct 1965	OV2-1 (LCS-2) (1965-82A)	USAF	L. Katz	Trapped Radiation Measurements	ETR Launch Vehicle Failure
4 Dec 1965	Gemini 7 (1965-100A)	NASA	J. Lovett	Radiometric Measurements	Success
9 Dec 1965	No Name (1965-102A)	USAF	R. Filz	Cosmic Radiation (Nuclear Emulsions)	Success
21 Dec 1965	OV2-3	USAF	B. Shuman R. Sagalyn L. Katz	Magnetic Fields Electrical Structure Cosmic Radiation Studies	ETR Launch Transtage Separation Failed

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
9 Mar 1966	No Name (1966-18A)	USAF	R. Filz	Cosmic Radiation	Success
30 Mar 1966	OV1-5 (1966-25B)	USAF	J. Lovett	UV-visible-11IR Radiation Satellite (3 Radiometers & 2 Interferometers)	Success
7 Apr 1966	No Name (1966-29A)	USAF	R. Filz	Cosmic Radiation	Success
22 Apr 1966	OV3-1 (1966-34A)	USAF	L. Katz L. Katz L. Katz R. Sagalyn	Proton Measurements (Spectrometer) Electron Measurements (Spectrometer) Low Energy Electrons (Electrostatic Analyzer) Plasma Probes	Success Success Success Success
24 May 1966	No Name (1966-42A)	USAF	R. Filz	Cosmic Radiation	Success
21 Jun 1966	No Name (1966-55A)	USAF	R. Filz	Cosmic Radiation	Success
13 Jul 1966	OV1-7	USAF	J. Ely	Cosmic Radiation Satellite Experiment	Vehicle Failure

Satellite Experiments - 1958 - Present (cont.)

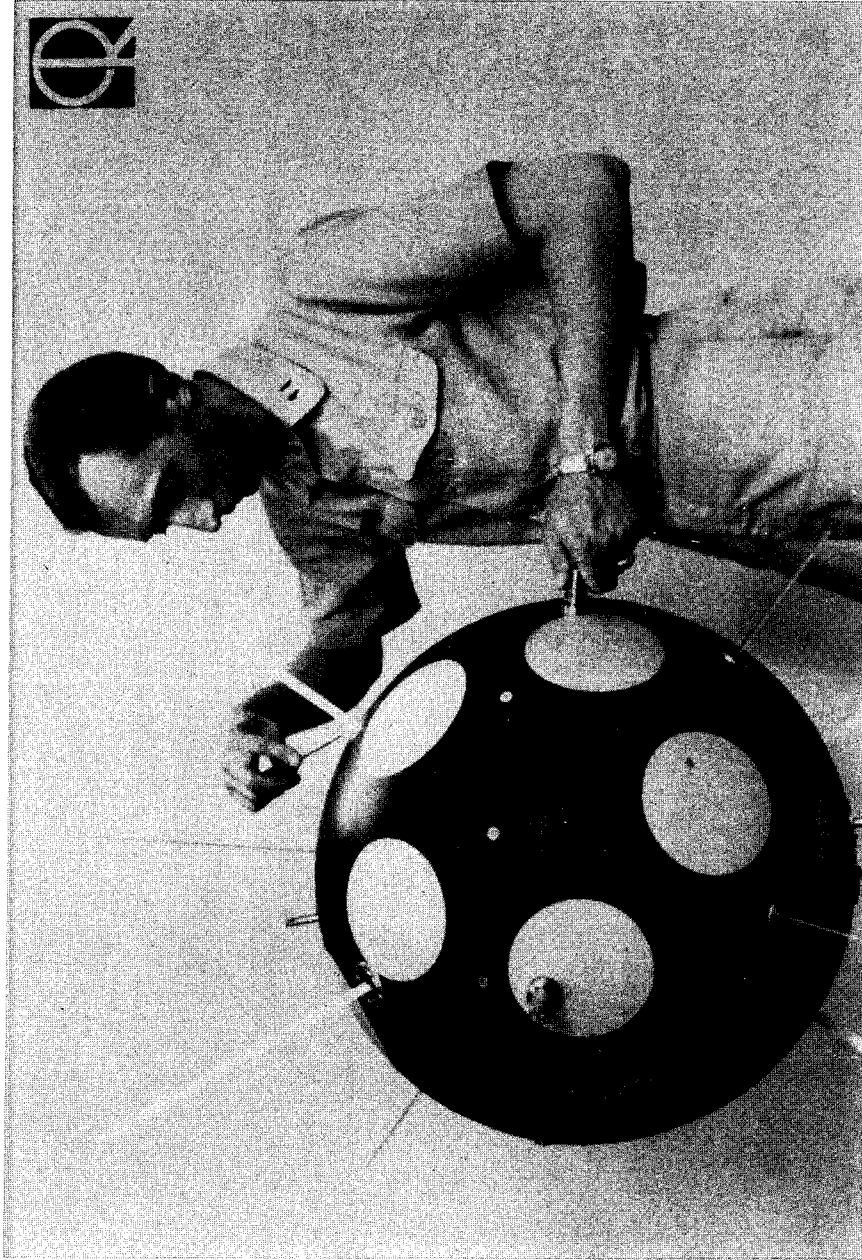
Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
18 Jul 1966	Gemini 10 (1966-66A)	NASA	R. Sagalyn	Ion Attitude Sensors	Success
9 Aug 1966	No Name (1966-72A)	USAF	R. Filz	Trapped Radiation	Success
28 Oct 1966	OV3-2 (1966-97A)	USAF	J. Ulwick J. Ulwick H. Cohen M. Smiddy J. Sandock	RF Probe Electrostatic Analyzer Quadrupole Mass Spectrometer Plasma Probe Retarding Potential Analyzer	Success Success Success Success Success
11 Nov 1966	Gemini 12	NASA	R. Sagalyn	Ion Attitude Sensors	Great Success After Fuel Cells Malfunctioned, Ion Sensors Were Used to Realign Gemini for Operations & Reentry
11 Dec 1966	OV1-9	USAF	J. Aarons L. Katz V. Smalley V. Smalley V. Smalley V. Smalley V. Smalley	Exospheric Proton Gyrofrequency Electrostatic Analyzer Geiger Counter Electron Magnetic Analyzer Proton Spectrometers Electron Spectrometer Proton Range Energy Telescope	Success Partial Success Partial Success Success Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
11 Dec 1966	OV1-10	USAF	J. Ely R. Hutchinson	Heavy Primary Detector Magnetic Field Measurements	Success Failure
31 Jan 1967	OV3-5 (ATCOS I)	USAF	R. Narcisi J. Ulwick J. McIsaac	Mass Spectrometers (2) Ion Density Gauge (3) Impedance Probe	AFCRL-Built Failed to Orbit
Mar 1967	OSO-III	USAF	H. Hinteregger L. Hall	Monochromator for Solar EUV	Eastern Test Range Launch Success
28 Apr 1967	OV5-1	USAF	G. Yates	Magnetospheric Experiments	Success
4 Jun 1967	No Name	USAF	R. Filz	Cosmic Radiation	Success
27 Jul 1967	OV1-86	USAF	J. Lovett V. Smalley	Earth & Cloud IR/Cosmic Radiation Atomic Oxygen	Success Success
28 Jul 1967	OGO-4	NASA	H. Hinteregger D. Bedo	Solar EUV Radiation (Spectrometer)	Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
5 Dec 1967	OV3-6 (ATCOS II)	USAF	R. Narcisi J. Ulwick ' J. McIsaac	Latitudinal Variations in Neutral & Ion Species Electron Density & Temperature Atmospheric Density	AFCRL-Built Success
9 Dec 1967	No Name	USAF	R. Filz	Cosmic Radiation	Success
24 Jan 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success
4 Mar 1968	OGO-5	NASA	R. Sagalyn	Charged Particles at 0-2.5 keV	Success
14 Mar 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success
30 Mar 1968	OV1-13	USAF	L. Katz	Trapped Radiation Flux	Success
1 May 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success
20 Jun 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success
11 Jul 1968	OV1-15 OV1-16	USAF	R. Philbrick K. Champion K. Champion	SPADES - Mass Spectrometer & Accelerometer Cannonball I - Density Accelerometer	Launched Together Success Low Altitude Density Research Satellites
7 Aug 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success



Installing Antennas on the Cannonball I Satellite (OV1-16).

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
8 Aug 1968	Explorer 40 (Injun V)	NASA	R. Sagalyn	Charged Particles & Electron Fields	Success
18 Sep 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success
26 Sep 1968	OV2-5	USAF	B. Shuman J. Mullen M. Smiddy	Geomagnetic Storms/ Ionospheric Scintillations/ Composition	Success
3 Nov 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success
12 Dec 1968	No Name	USAF	R. Filz	Cosmic Radiation	Success
5 Feb 1969	No Name	USAF	R. Filz	Cosmic Radiation	Success
18 Mar 1969	OV1-17 OV1-17A	USAF	A. Barnes J. Mullen	Calibration of Meteor Trail Antenna Calibration of Entrapped Radio Signals in the Ionosphere	ETR Launch Success Transmitted Data Until 1976

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
2 May 1969	No Name	USAF	R. Filz	Cosmic Radiation	Success
23 May 1969	OV5-6	USAF	K. Yates	Solar X-rays & Particle Radiation Experiments	Success
5 Jun 1969	OGO-6	NASA	H. Hinteregger	UV Solar Radiation (Spectrophotometer)	Success
16 Jul 1969	Apollo 11	NASA	D. Eckhardt	Lunar Laser Ranging Experiment	Success
			D. Eckhardt	Backup Retroreflectors	Not Used
24 Jul 1969	No Name	USAF	R. Filz	Cosmic Radiation	Success
22 Sep 1969	No Name	USAF	R. Filz	Cosmic Radiation	Success
4 Dec 1969	No Name	USAF	R. Filz	Cosmic Radiation	Success
4 Mar 1970	No Name	USAF	R. Filz	Cosmic Radiation	Success
20 May 1970	No Name	USAF	R. Filz	Cosmic Radiation	Success
23 Jul 1970	No Name	USAF	R. Filz	Cosmic Radiation	Success
18 Nov 1970	No Name	USAF	R. Filz	Cosmic Radiation	Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
7 Aug 1971	OV1-20	USAF	K. Champion	Cannonball II Satellite Low-Altitude Density Experiment (Accelerometer)	OV1-20 & OV1-21 Payloads Launched in Tandem on an Atlas F All Experiments Successful
7 Aug 1971	OV1-21	USAF	K. Champion R. Narcisi C. Philbrick J. McIsaac	(1) Musketball Satellite Low-Altitude Density Experiment (Radar Tracking Beacon) (2) DENPER Satellite Velocity Mass Spectrometer Magnetic Mass Spectrometer Ionization Gauges	
19 Apr 1972	No Name	USAF	R. Filz	Cosmic Radiation	Success
25 May 1972	No Name	USAF	R. Filz	Cosmic Radiation	Success
2 Oct 1972	No Name (STP72-1)	USAF	L. Katz	Proton & Alpha Isotope Detector	Success
16 Dec 1973	Explorer 51 (AE-C)	NASA	H. Hinteregger F. Marcos	Solar EUV (Spectrometer) Density (Tri-Axial Accelerometer)	Success Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
1974	S3-1	USAF (STP)	LK F. Marcos C. Philbrick	Single-Axis & Piezoelectric Accelerometers Ionization Gauge/Neutral Mass Spectrometer	Success Success
1975	S3-2	USAF (STP)	LK C. Philbrick F. Marcos PH LI	Neutral Mass Spectrometer/ Ionization Gauge Piezoelectric Accelerometer Electric Field, Magnetic Field Auroral Particles, Thermal Plasma	Success Success Success
6 Oct 1975	Explorer 54 (AE-D)	NASA	LK H. Hinteregger K. Champion	Solar EUV (Spectrometer) Density (Tri-Axial Accelerometer)	Success Success
20 Nov 1975	Explorer 55 (AE-E)	NASA	LK H. Hinteregger K. Champion	Solar EUV (Spectrometer) Density (Tri-Axial Accelerometer)	Success Satellite Functional Until 6/10/81
15 Mar 1976	SOLRAD11A SOLRAD 11B	USAF	PH L. Katz	Protons & Alpha Particles	Satellites Launched Together Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
May 1976	S3-3	USAF (STP)	PH	Thermal Plasma	Success
4 May 1976	LAGEOS Laser Geodetic Satellite	NASA	D. Eckhardt	Concept Review & Specification-Panel Member	Passive Reflector System
11 Sep 1976	AMS1 (DMSP)	US	PH	Defense Meteorological Satellite Program (DMSP) Electrostatic Analyzers (SSJ/2)	WTR Launch Success
14 Jan 1977	No Name (1977-02A)	USAF	PH R. Filz	Trapped Radiation	Success
Jun 5 1977	DMSP-F2	USAF	PH P. Rothwell	Electrostatic Analyzers (SSJ/3)	WTR Launch Success
Mar 1978	S3-4	USAF (STP)	LK R. Huffman F. Marcos	UV Backgrounds Sensor Density Accelerometers	Success Success
1 May 1978	DMSP-F3	USAF	PH P. Rothwell	Electrostatic Analyzers (SSJ/3)	WTR Launch Success

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
1979	SETA 1	USAF	LK F. Marcos	Density-Triaxial Accelerometer	Success Provided Accurate Satellite Positioning Techniques
30 Jan 1979	SCATHA (P78-2)	USAF/ NASA	PH C. Pike H. Cohen	Electric Fields Particle Flux Monitors Active Discharging Devices	Success Spacecraft Charging at High Altitudes
25 Feb 1979	Solwind (P78-1)	USAF	PH R. Vancour	Electron Detectors (Electrostatic Analyzers)	Success Target for USAF ASAT6 13 Sep 1985
6 Jun 1979	DMSP-F4	USAF	PH D. Hardy F. Rich	SSJ/3 Sensor Special Sensor Ions & Electrons (SSIE)	Success
14 Feb 1980	SMM	NASA	PH	Participation in Experiments	Solar Maximum Mission

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
14 Jul 1980	DSMP-F5	USAF	PH D. Hardy F. Rich	SSJ/3 SSIE	Launch Vehicle Failure
1982	SETA-2	USAF	LK F. Marcos	Density - Triaxial Accelerometer	Success
21 Dec 1982	DMSP-F6	USAF	PH D. Hardy F. Rich	Electrostatic Analyzers (SSJ/4 Special Sensor Ions & Electrons (SSIE)	Success Satellite Taken Out of Service Aug 1987
1983	SETA-3	USAF	LK F. Marcos	Triaxial Accelerometer	Success
27 Jun 1983	HILAT	DNA/SD	LK R. Huffman PH D. Hardy F. Rich	Auroral Ionospheric Mapper SSJ/3 Plasma Measurements Package	High-Latitude Satellite

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
18 Nov 1983	DMSP-F7	USAF	PH F. Rich D. Hardy	SSIE, SSJ/4, Fluxgate Magnetometer (SSM) & Dosimeter (SSJ*)	Success Satellite Ceased Operating Mar 1988
1984	S85-1	USAF	LI F. Marcos	Triaxial Accelerometer-Density	Success
13 Nov 1986	POLAR BEAR	DNA	LI R. Huffman	Auroral/Ionospheric Remote Sensor (AIRS)	Success
19 Jun 1987	DMSP-F8	USAF	PH D. Hardy F. Rich	SSJ/4 Electron Flux SSIES Plasma Monitor	Functioning in Orbit
3 Feb 1988	DMSP-F9	USAF	PH D. Hardy F. Rich	SSJ/4 SSIES Sensors	Success Satellite Failure April 1992
14 Feb 1990	RME/LACE	SDIO	OP R. Beland	Relay Mirror Experiment	Optical Turbulence Support Studies

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
25 Jul 1990	CRRES	USAF/ NASA	PH E.G. Mullen	<u>18 SPACERAD Experiments</u> Microelectronics Package Internal Discharge Monitor Dosimeter MOS Dosimeter High Energy Electron Spectrometer Medium Energy Electron Spectrometer Medium Energy Electron/Proton Spectrometer Low Energy Plasma Analyzer Range Telescope Proton Switches Proton Telescope Magnetospheric Ion Composition Spectrometer Low Energy Magnetospheric Ion Composition Spectrometer Heavy Ion Telescope Fluxgate Magnetometer Search Coil Magnetometer Thermal Plasma Probe Passive Plasma Sounder	Combined Release/Radiation Effects Mission Successful Launch Data Obtained From All Experiments Except the Heavy Ion Telescope & the Low Energy Magnetospheric Ion Composition Spectrometer Data From These Last Two Were Limited Satellite Power Supply Failed 12 Oct 1991

DMSP SPACE ENVIRONMENT MEASUREMENTS

SPACE PLASMA PROPERTIES

PRECIPITATING
PARTICLES

SSJ/4

SSIE

SSJ*

THERMAL
PLASMA

SSM

The Complement of AFGL Sensors on DMSP F-7

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
25 Jul 1990	CRRES	USAF/NASA	LI D. Hunton	Mass Spectrometer (LASSII)	Obtained Partial Data
1 Dec 1990	DMSP-F10	USAF	PH D. Hardy F. Rich	SSJ/4 SSIES Sensors	Functioning in Orbit
28 Nov 1991	DMSP-F11	USAF	GPS D. Hardy F. Rich	SSJ/4 SSIES Sensors	Functioning in Orbit
22 Nov 1992	MST1-1	SDIO	SXA	Miniature Sensor Technology	Scout-Launched Integration & Test Support
8 May 1994	MST1-2	BMDO	SXA	Miniature Sensor Technology	Scout-Launched Integration & Test Support
27 Jun 1994	ADS (AF STEP-1)	USAF	GPI F. Marcos	Atmospheric Density Satellite	Pegasus XL Launch from an L-1011 Launch Failure

Satellite Experiments - 1958 - Present (cont.)

Date of Launch	Vehicle	Sponsor	Division/PI	Payload/Experiments	Comments
3 Aug 1994	APEX (STEP-2)	USAF	GPS D. Guidice P. Severance	Photovoltaic Array Space Power Plus Diagnostics (PASP <i>Plus</i>) Experiment	Success Standard Pegasus Launch from a B-52
29 Aug 1994	DMSP-F12	USAF	GPS F. Rich M.S. Gussenhoven	SSIES-2, SSJ4, SSM Sensors	Successful Launch
1 Nov 1994	WIND	NASA	GPS E. Cliver	Solar Wind Interplanetary Measurements (SWIM) Experiment	Successful Launch

AFGL/Phillips Lab-Hanscom Space Shuttle Experiments, 1982 - Present*

*As of November 1994

Date of Launch	Vehicle	Division/PI	Payload/Experiments	Comments
		OP D. Smith LC R. Wilton LK - PH R. Huffman R. Narcisi F. Rich R. Huffman M. Smiddy	Cryogenic IR Radiance Instrumentation for Shuttle (CIRRIS 1) <u>On the Secondary Experiments Test Sets (SETS-1) Pallet</u> UV Spectrometer Mass Spectrometer Energetic Particle Detector Electron Spectrometer Electric Fields Plasma Sensors	CIRRIS 1 Instrument Cover Failed to Open SETS-1 Instruments Obtained Data Mass Spectrometer Reflow on STS-46
28 Nov 1983	Columbia STS-9	PH C. Pike W. Denig R. Viereck	Auroral Photography Experiment (APE)	No data APE Was Reflowed & Obtained Data on Nine Subsequent Shuttle Missions (STS-17, 29, 33, 38, 41, 43, 52, 60, & 62)

AFGL/Phillips Lab-Hanscom Space Shuttle Experiments, 1982 - Present (cont.)

Date of Launch	Vehicle	Division/PI	Payload/Experiments	Comments
6 Apr 1984	Challenger STS-41C	PH F. Rich	<u>Under the Long Duration Exposure Facility</u> Cosmic Ray Experiment Materials Experiment	Retrieved 12 Jan 1990
30 Aug 1984	Discovery STS-14	LY W. Snow	CLOUDS Photography Experiment	CLOUDS Was Flown Again on Five Later Missions (STS-20, 21, 27, 28, & 33) Data Obtained on All Flights
29 Jul 1985	Challenger STS 51F (Spacelab 2)	PH G. Simon	Solar Optical Universal Polarimeter (SOUP)	Partial Success George Simon was Alternate Payload Specialist for the Spacelab 2 mission
3 Oct 1985	STS-51J	OP M. Ahmadjian	Measurement of Atmospheric Radiance Camera, Day/Night (MARC-D/N)	Success Obtained Data

AFGL/Phillips Lab-Hanscom Space Shuttle Experiments, 1982 - Present (cont.)

Date of Launch	Vehicle	Division/PI	Payload/Experiments	Comments
12 Jan 1986	Columbia STS-61C	OP M. Ahmadjian	Particle Analysis Cameras for Shuttle (PACS)	NASA Hitchhiker Payload Success
14 Mar 1989	STS-29	PHK E. Murad D. Knecht. E. Murad	AMOS Calibration Test	Reflown on 7 Subsequent Shuttle missions (STS 30, 33, 38, 41, 43, 44, and 56) Data Obtained on All Flights
28 Apr 1991 (cont.)	Discovery STS-39	OP R. Nadile LI R. Huffman LI D. Hunton PHK E. Murad D. Knecht	<u>Under AFP-675 Payload</u> Cryogenic IR Radiance Instrumentation for Shuttle (CIRRIS-1A) Horizon Ultraviolet Program (HUP) Quadrupole Ion Neutral Mass Spectrometer (QINMS) <u>Under the IBSS Payload</u> Arizona Imaging Spectrometer (AIS) Critical Ionization Velocity (CIV) Experiment	Mission Success Obtained Data Partial Data Partial Data Obtained Data Obtained Data



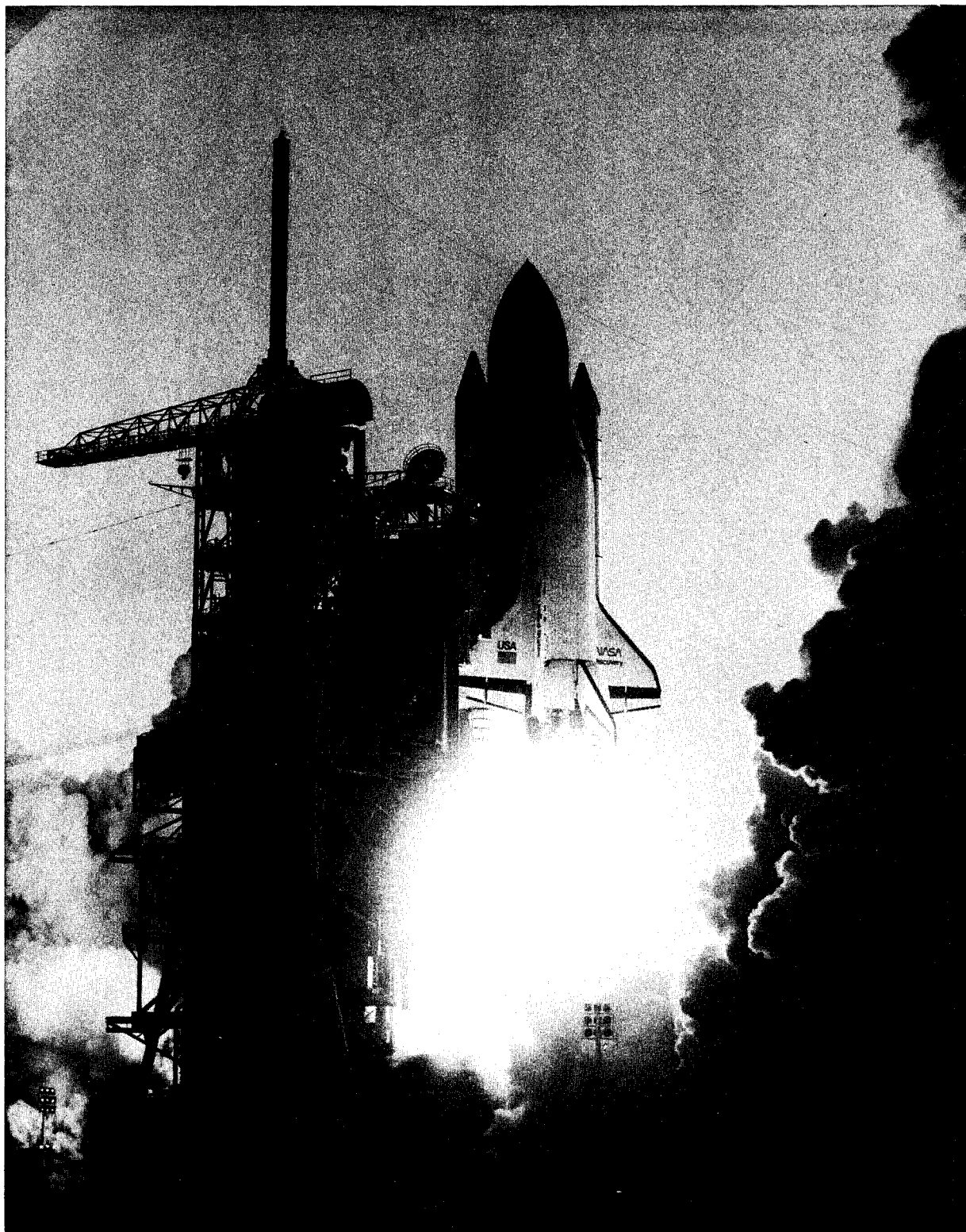
CLOUDS Photography: The Vertical Stabilizer of the Space Shuttle Dips over Maui, Hawaii, Where Cumulus Clouds Have Formed Above the Land Mass.

AFGL/Phillips Lab-Hanscom Space Shuttle Experiments, 1982 - Present (cont.)

Date of Launch	Vehicle	Division/PI	Payload/Experiments	Comments
28 Apr 1991 (cont.)	Discovery STS-39	PHK W. Denig OP R. Van Tassel LC W. Thorn R. McInerney OP M. Ahmadjian	<u>Under the IBSS Payload (cont.)</u> Pressure Gauge IBSS IR Sensor Data LLTV Cameras IBSS Data Reduction <u>Under the STP-1 Payload</u> Spacecraft Kinetic IR Test (SKIRT) Experiment	Obtained Data Obtained Data Obtained Data Obtained Data Obtained Data Get Away Special
22 Jan 1992	STS-42	GPO SXA P. LeVan	Visual Photometric Experiment (VIPER)	

AFGL/Phillips Lab-Hanscom Space Shuttle Experiments, 1982 - Present (cont.)

Date of Launch	Vehicle	Division/PI	Payload/Experiments	Comments
31 Jul 1992	STS-46	GPS M. Oberhardt D. Hardy	<u>Under Tethered Satellite (TSS-1) Payload</u> Shuttle Potential and Return Electron Experiment (SPREE)	Tether Failure Limited Data
		GPI D. Hunton	<u>Under the EOIM-III Payload</u> Quadrupole Mass Spectrometry Experiment	Fully Successful
Dec 1992	STS-53 (STP)	WSSI E. Murad D. Knecht R. Viereck	Shuttle Glow Experiment (GLO)	Success Obtained Data
3 Feb 1994	STS-60	GPS L. Enloe M. Violet	Charging Hazards and Wake Studies (CHAWS)	Success Obtained Data
4 Mar 1994	STS-62	GPO M. Ahmadjian	Spacecraft Kinetic IR Test Experiment (SKIRT-2)	Success Obtained Data



The Launch of the Space Shuttle Discovery (STS-39), 28 April, 1991. STS-39 Carried CIRRS 1A and Nine Other Phillips Lab/Hanscom Experiments.

NASA Photo